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BEFORE THE PUBLIC UTILITIES COMMISSION

OF THE STATE OF CALIFORNIA

Application of the City of Santa Rosa for Approval to Construct a Public Pedestrian and Bicycle At-Grade Crossing of the Sonoma-Marin Area Rail Transit ("SMART") Track at Jennings Avenue Located in Santa Rosa, Sonoma County, State of California.	Application No. 15-05-014 (Filed May 14, 2015)

PETITION OF THE CITY OF SANTA ROSA TO MODIFY DECISION NO. 16-09-002

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Dated: April 19, 2019

BEFORE THE PUBLIC UTILITIES COMMISSION

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Application of the City of Santa Rosa for Approval to Construct a Public Pedestrian and Bicycle At-Grade Crossing of the Sonoma-Marin Area Rail Transit ("SMART") Track at Jennings Avenue Located in Santa Rosa, Sonoma County, State of California.	Application No. 15-05-014 (Filed May 14, 2015)

PETITION OF THE CITY OF SANTA ROSA TO MODIFY DECISION NO. 16-09-002

In accordance with Rule 16.4 of the Commission's Rules of Practice and Procedure, the City of Santa Rosa (City) hereby respectfully submits its Petition to Modify Ordering Paragraph 7 of Decision No. 16-09-002 to extend the Commission's authorization to construct an at-grade pedestrian and bicycle crossing at Jennings Ave. from September 20, 2019 to September 20, 2021.

I. INTRODUCTION

On September 20, 2016, the Commission issued Decision No. 16-09-002 granting the City's application to construct an at-grade pedestrian and bicycle crossing across the Sonoma-Marin Area Rail Transit (SMART) tracks at Jennings Avenue in Santa Rosa. In approving the City's design for the proposed crossing, the Commission noted the following:

> The City has made a convincing showing that it has eliminated all potential safety hazards. The proposed crossing has been designed to comply with numerous legal requirements. The design is ADA compliant. The design includes protection and warning devices in compliance with federal and State regulations (including GO 75-D, Caltrans Highway Design Manual path standards, California Manual of Uniform Traffic Control Devices, and Federal Highway Administration Railroad-Highway Grade Crossing Handbook…As

part of the design process, the City consulted with SMART[1] and SED.

The City states that Pedestrian Clearing Sight Distance is sufficient (visibility 1500 to north and 2000 feet to south), but safety devices including "fencing, emergency swing gates, pavement markings, truncated domes, flashing light signals, audible devices and automated pedestrian arms/gates will be installed."

SED has stipulated that the proposed design meets all legal requirements.[2]

Ordering Paragraph 7 of D. 16-09-002 reads as follows:

> This authorization shall expire if not exercised within three years of the issuance of this decision unless time is extended or if the above conditions are not satisfied.

By this filing, and for the reasons set forth below, the City requests an extension of the Commission's authorization to construct an at-grade pedestrian and bicycle crossing at Jennings Ave.

II. REQUEST FOR EXTENSION OF COMMISSION AUTHORIZATION

To date, the City has not made any significant modifications to the plans for the Jennings Ave. crossing that were developed in conjunction with SED and SMART and that were approved by the Commission in D. 16-09-002.

Immediately following the issuance of D. 16-09-002, the City and SMART began developing a cooperative agreement that would allow the City to compensate SMART for constructing the crossing. Unfortunately, this process took several months of back and forth negotiating, ultimately resulting in final language in June 2017. That agreement was executed by the City Manager on June 13, 2017, and hand-delivered to SMART on June 14, 2017,

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[1] While SMART was not a party to A. 15-05-014, it submitted a letter supporting the City's efforts to install an at-grade pedestrian and bicycle crossing at Jennings Avenue, emphasizing that the City has worked in conjunction with SMART to take the necessary steps to ensure that rail operations and services in Santa Rosa will be conducted in a manner that is safe for the travelling public.

[2] D. 16-09-002; *mimeo.* at pp. 29-30.

anticipating execution by the SMART Board of Directors at their June 21, 2017, meeting. SMART did not agendize this item, and it took several months for the two agencies to discuss the areas of concern due to the 2017 Tubbs Fire that devastated the City of Santa Rosa.

Following a series of discussions, SMART issued a letter to the City on August 20, 2018, stating that it no longer supported an at-grade crossing at Jennings Avenue, stating that the proposed crossing design did not provide adequate safety for the public. In follow-up meetings between the City and SMART in December, 2018, SMART indicated that it would be willing to consider the at-grade crossing if the City made significant improvements in the design for pedestrian safety.

To address SMART's safety concerns, the City engaged GHD Engineering to research and identify all available safety options currently being used in both the United States and throughout the world that could be implemented at the Jennings Avenue crossing . By correspondence dated April 12, 2019, the City informed SMART of the City's willingness to incorporate additional safety measures in an effort to obtain SMART's concurrence to proceed with the at-grade bicycle and pedestrian crossing at Jennings Avenue and provided SMART with GHD's technical memorandum and the City's recommended additional safety measures.[3] Specifically, the City proposes to address SMART's concerns by incorporating a "Z" style crossing that appears to be preferred by SMART, by adding wayside horns at the Jennings Avenue crossing, and by using larger ballast between the tracks which will make it nearly impassable for errant pedestrians to attempt accessing the southerly service stairway at the Santa Rosa North Station platform.

[3] The City's April 12, 2019 correspondence to SMART, along with the GHD technical memorandum, is included as Attachment A hereto.

The City continues to support the Commission's conclusion that an at-grade bicycle and pedestrian crossing at Jennings Avenue is in the public interest and that there is a public need for the crossing.[4] Consistent with considerations of public safety and local community interest, the City remains firmly committed to construction of the at-grade crossing as approved by the Commission. Nevertheless, the City, remaining mindful of concerns raised by SMART, has undertaken a significant effort to address such concerns and is prepared to incorporate the three additional safety measures described above as well as to discuss any other safety features identified by GHD in an effort to satisfy SMART's concerns.

To accommodate the City's efforts to reach a satisfactory resolution with SMART by adding safety enhancements at the Jennings Ave. at-grade crossing, the City now asks the Commission to toll expiration of the authorization granted by D. 16-09-002 and to extend the authority for the City to construct an at-grade crossing of Jennings Ave. until September 20, 2021.

III. CONCLUSION

Wherefore for the reasons set forth herein, the City requests that Decision No. 16-09-002 be modified to extend the date for authority to construct a pedestrian and bicycle at-grade crossing of Jennings Ave. from September 20, 2019 to September 20, 2021.

[4] Decision No. 16-09-002; Conclusion of Law 4; Decision No. 16-09-002; Conclusion of Law 4; *mimeo.* at p. 40

Respectfully submitted April 19, 2019, at San Francisco, California.

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By */s/James D. Squeri*
James D. Squeri

Attorneys for City of Santa Rosa

3634/001/X207296.v1

ATTACHMENT A

City of Santa Rosa
TRANSPORTATION & PUBLIC WORKS

April 12, 2019

Bill Gamlen, P.E.
Chief Engineer
Sonoma Marin Area Rail Transit
5401 Old Redwood Highway, Suite 200
Petaluma, CA 94954

JENNINGS AVENUE PEDESTRIAN AT-GRADE CROSSING – GHD TECHNICAL MEMORANDUM

Dear Mr. Gamlen:

In response to direction from ALJ Chiv given during the February 12, 2019 status briefing meeting, the City reengaged GHD to research and identify all available safety options currently being used in both the United States and throughout the world that could be implemented at the Jennings Avenue Crossing to address the concerns raised about the proposed at-grade crossing. GHD documented that research in the attached technical memorandum.

Both GHD and the City firmly believe that the concerns raised can be more than adequately addressed by incorporating a "Z" style crossing that appears to be preferred by SMART as it is being proposed and implemented at all other at-grade road crossing within the City limits. Additionally, GHD and the City believe that adding wayside horns at the Jennings Avenue Crossing will compensate for SMART's concerns associated with the existing Quiet Zone and the use of larger ballast between the tracks will make is nearly impassable for errant pedestrians to attempt accessing the southerly service stairway at the Santa Rosa North Station platform.

As you are aware, in December 2014, the City of Santa Rosa contracted with GHD Engineering to develop design and construction plans for an at-grade rail crossing of the SMART tracks at Jennings Avenue. Throughout the development process, GHD coordinated design efforts with City, SMART and CPUC staff. In May 2017, the Safety Enforcement Division (SED) of the CPUC concluded that the completed design conforms to State and Federal design standards and includes safety elements that have been standardized along much of the Sonoma Marin Area Rail Transit (SMART) corridor.

As requested by ALJ Chiv, the City has performed its due diligence and is willing to incorporate the three additional safety measures described above and open to discussing any other safety features identified by GHD in an effort to receive SMART's concurrence to proceed with the at-grade bicycle and pedestrian crossing at Jennings Avenue. To complete this process, I am requesting that you review GHD's technical memorandum and the City's recommended

additional safety measures and provide a response to our request to finalize the construction agreement by May 30, 2019.

Please let me know if you have any questions and we look forward to reengaging our partnership on this project.

Sincerely,

JASON L. NUTT
Director of Transportation and Public Works

Attachment: Technical Memorandum

JLN/mah [ISMARTJenningsAt-GradeGHD041219.docx]

c: Santa Rosa City Council
ALJ Debbie Chiv, California Public Utilities Commission
David Stewart, Rail Crossings and Engineering Branch, California Public Utilities Commission
Sue Gallagher, City Attorney
John Fritch, Assistant City Attorney
James Squeri, Esq.

JENNINGS AVENUE AT-GRADE RAIL CROSSING - TRAFFIC CONTROL OPTIONS TECHNICAL MEMORANDUM

April 1, 2019

To:	Gregory Dwyer, Project Manager, City of Santa Rosa Rob Sprinkle, City Traffic Engineer, City of Santa Rosa		
Cc:	Matt Wargula, Project Manager, GHD		
From:	Frank Penry, PE, TE, PTOE	Tel:	707-523-1010
Subject:	Jennings Avenue Bicycle & Pedestrian At-Grade Rail Crossing – Traffic Control Options	Job no.:	8411930-080

1 Introduction

It is understood that the California Public Utilities Commission (CPUC) approval of the City's formal application for an at-rail grade rail crossing at Jennings Avenue, in the City of Santa Rosa, has met with objection by the Sonoma Marin Area Rail Transit (SMART). This objection, or challenge of the approval is further understood to be based on the safety concerns regarding the presence of multi-track through the proposed at-grade rail crossing.

The approved proposed design conforms to State and Federal design standards with regard to rail grade crossings of bicycle and pedestrian facilities, inclusive of accessibility, active warning devices, automatic and swing gates, and fencing for channelization. The safety elements provided in the design are used to mitigate visibility constraints at multi-track crossings, and they have been standardized along much of the SMART alignment.

This memorandum presents additional passive and active traffic control devices as options to supplement the active railroad control devices proposed at the Jennings Avenue at-grade rail crossing. The list is not comprehensive, but provides a variety of options which may be refined to conform to standard conditions and CPUC General Orders, as required for use. Provided from standard reference sources, these supplemental alternatives may be considered at crossings with high pedestrian traffic volumes; high train speeds or frequency; extremely wide crossings; complex grade crossing geometry with complex right-of-way assignment; school zones; inadequate sight distance; and/or multiple tracks. Additionally, pedestrian facilities should be designed to minimize pedestrian crossing time, and devices should be designed to avoid trapping pedestrians between sets of tracks.

2 Reference Documents

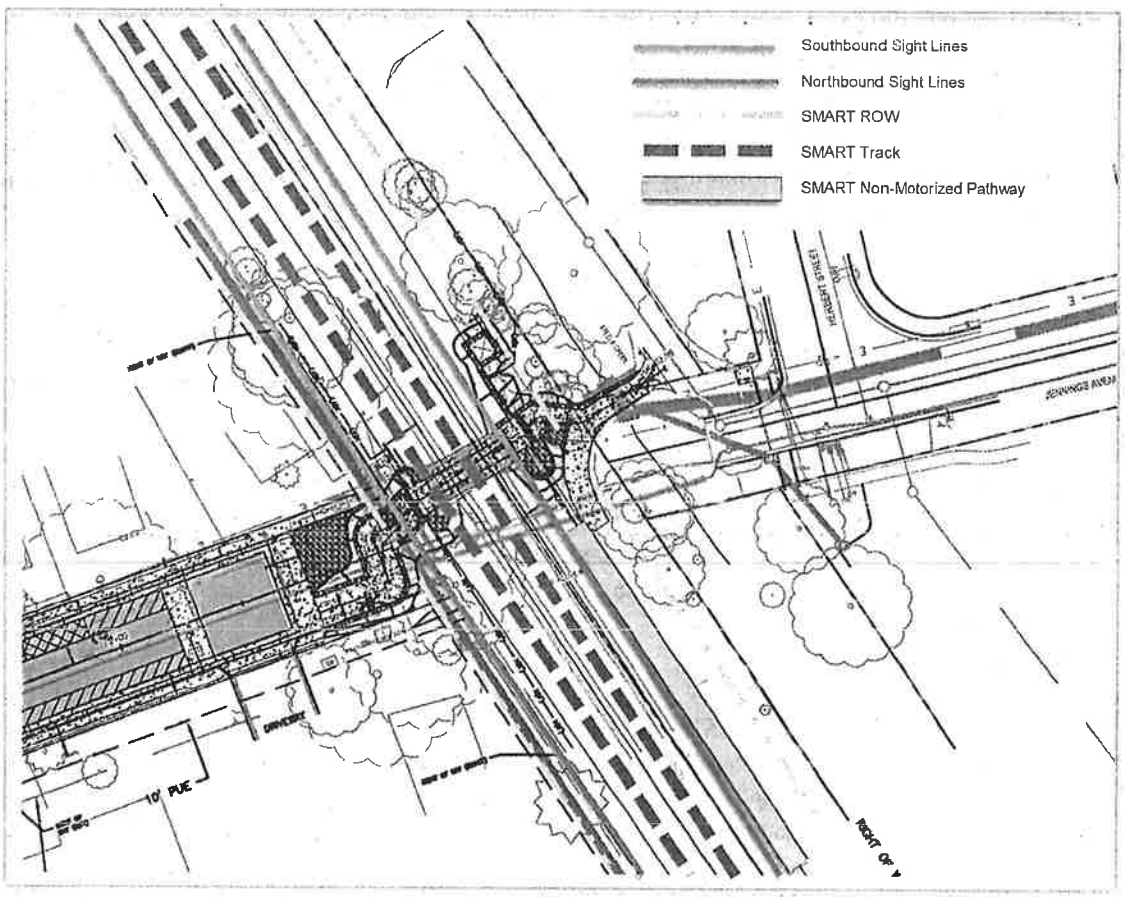
A list of resources are provided on the CPUC's Rail Crossings and Engineering Branch, Rail Crossing Design References Webpage[i], including, but not limited to the FHWA Railroad-Highway Grade Crossing Handbook[ii], California Manual on Uniform Traffic Control Devices (CAMUTCD)[iii], and CPUC's Pedestrian-Rail Crossings in California[iv]. In addition, the following sources were reviewed UDOT Pedestrian Grade Crossing Manual[v], FRA's Compilation of Pedestrian Safety Devices In Use at Grade Crossings[vi], and Australian Standard (AUMUTCD), Part 7: Rail Crossings[vii]. While the last reference, AUMUTCD may differ from US State and Federal standards, the alternatives are provided to represent proven alternative standardized measures.

3 Sight Distance

In order to address concerns of clearing sight distance and sight triangles for the subject crossing, Pedestrian Sight Triangles (Sight Lines) are shown on the design drawing below, using the maximum design vehicle speed for this segment of track (79 mph) and a pedestrian decision point at 17 feet on either side of the approaching track centerline. While the prevailing direction of travel for respective trains is on the right, similar to a roadway, sight lines are shown for both directions on both tracks.

The distance the pedestrian travels from one side of the crossing to the other is 42 feet. There are two tracks in the crossing, separated by 15 feet, active at-grade crossing equipment is 15 feet from centerline of the nearest track. The distance is broken up into the following categories:

- 7 ft. Decision/Reaction Distance of 2 seconds at 3.5 feet per second (fps). Note slower speeds, as low as 1.5 fps, should be used where slower moving pedestrians are expected;
- 10 ft. Clearance Area just before a rail track;
- 15 ft. between two rail tracks;
- 10 ft. from last rail track to clearance area.



Rail Crossing Layout, Jennings Avenue At-Grade Rail Crossing.

As provided, the Pedestrian Sight Triangles (Sight Lines) appear to be just inside existing vegetation, identified trees, and the proposed Central Instrument House (CIL), however the need for further clearing within SMART ROW should be verified with construction of the at-grade crossing. If possible, the CIL may require additional setback to maximize the sight distance in the northbound direction.

4 Proximity to Santa Rosa North Station (Guerneville Road Station)

The proposed Jennings Avenue at-grade crossing is approximately 1,050 feet south from the Santa Rosa North Station, which is within ¼-mile from the station platform. A ½-mile to ¼-mile walking distance is often used by planners and engineers as an acceptable walking distance to and from transit facilities. Due to proximity and clear line of sight to the Santa Rosa North Station from the proposed at-grade crossing at Jennings Avenue, additional measures may be taken to discourage trespassing within the rail right-of-way.

- Install video surveillance system to monitor and assist in enforcement of rail right-of-way
- Provide increased enforcement presence at the Santa Rosa North Station
- Implement sustained community education/outreach on highway-rail grade crossing safety and the prevention of railroad trespassing
- Install courser (increased diameter) gradation ballast in non-critical rail access areas to discourage walking within the rail right-of-way

The first three measures are discussed in more detail in Federal Railroad Administration's Railroad Trespassing, Vandalism and Highway-Rail Grade Crossing Warning Devise Violation Prevention Strategies[viii]

5 Passive Devices

Passive devices include fencing; swing gates; pedestrian barriers; pavement markings and texturing; refuge areas; and fixed message signs. It should be noted that the proposed at-grade crossing design already includes a number of these types of devices as a standard to CPUC requirements.

5.1 Channelization – "Z" Crossing

This alternative (graphic next page) is developed to offset or channelize pedestrians from the most direct path of travel through the automatic gate on approach to an at-grade crossing. In effect guiding them in a zig-zag or "Z" path, which turns them in the direction of the prevailing traffic of the nearest track prior to making the decision to cross. This approach is introduced to slow and channelize users for preferential sight lines to approaching trains. Often used in combination with an Offset Crossings of the tracks, this alternative may be used alone. Traditional channelization is provided with a vertical fence type barrier, described as "Pedestrian Barriers at an offset Grade Crossing".

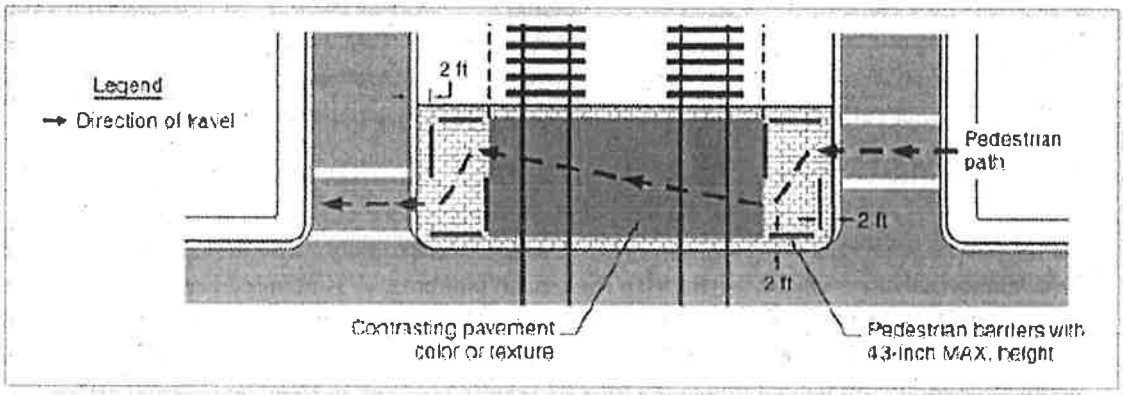
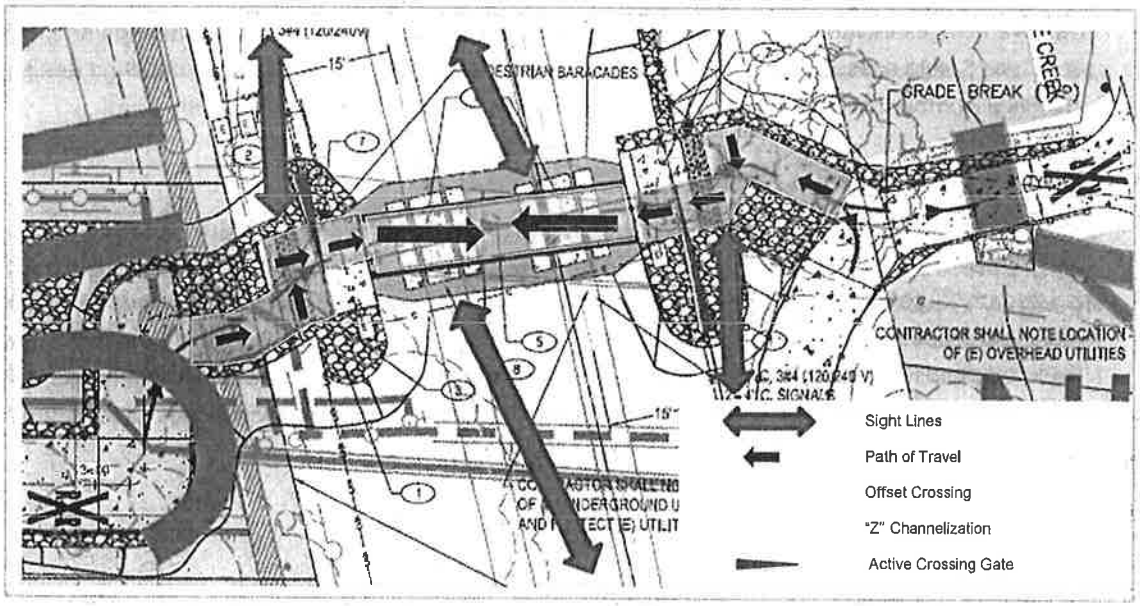


Figure 8C-9 Example of Pedestrian Barriers at an Offset Grade Crossing, CAMUTCD.

This alternative is further detailed with the existing site constraints on the attached Exhibit 1 Rail Crossing Layout. As provided on the detail below the pedestrian pathways on either side of the crossing are developed in a "Z" to improve the decision to cross. The full width pathway has been narrowed by half (6 feet) to provide offset on approach from the direct path of travel through the automatic gate. Further, an offset crossing has been provided to the path across the tracks, created by flipping the gates opposite each other. This turns users back in the direction of the prevailing traffic of the adjacent track prior to making the decision to cross. It should be noted that grades and accessibility requirements present an obstacle to providing more significant channelization or offset. This layout shows an alternative, within the existing project constraints, to provide both channelization and crossing offset.



Path of Travel and Sight Lines – Jennings Avenue At-Grade Rail Crossing.

5.2 Offset Crossing

This alternative as provided in references allows for center refuge between the tracks, or uses an angled crossing of the tracks to significant offset between the entrance/exit paths. In some cases an angled crossing of the railroad tracks is provided, rather than using offset perpendicular paths with a center parallel path between the tracks. In this case, there is not enough clearance between the tracks to provide parallel path.

Where in many cases the approaches are able to be offset, the existing conditions at the subject grade crossing are a constraint to a more measurable offset at this location. Examples of this type of offset are provided below.

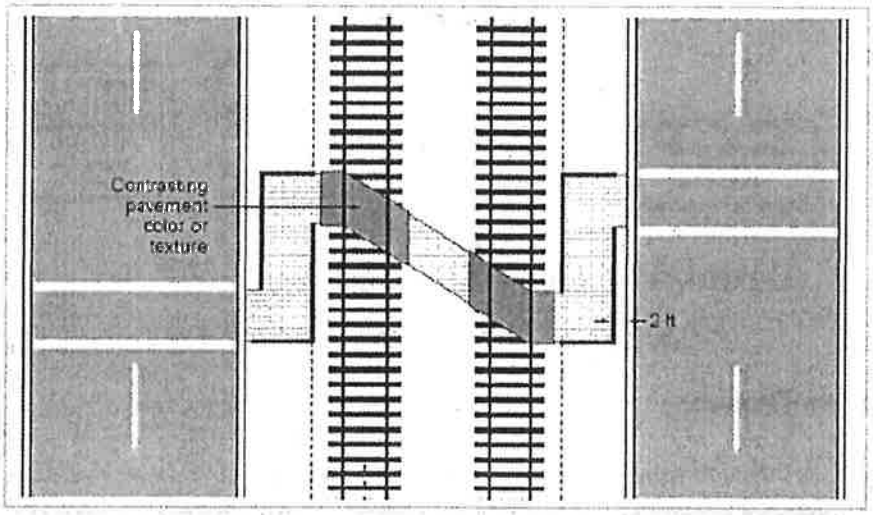


Figure 8C-10 Examples of Pedestrian Barrier Installation at an Offset Non-Intersection Grade Crossing, CAMUTCD.

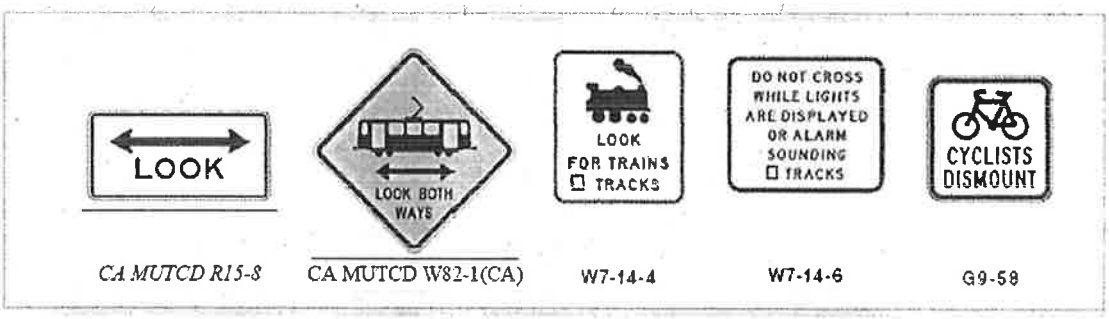
5.3 Contrasting Pavement – Pathway Delineation

Recommended in the examples for both the Channelized and Offset alternatives, is the use of contrasting pavement of the crossing. Pavement markings advising pedestrians to "LOOK" at each crossing of the tracks is a further enhancement.

Colored Pavement at Rail Crossing in Sacramento,
CPUC Pedestrian-Rail Crossings in California.

5.4 Signage

Regulatory and warning signage at the subject crossing is provided in conformance with CPUC requirements, however additional signage could alternatively be provided. Given the proposed alterations to the path of travel, it is advised that signage indicating cyclist dismount is advised. Further, additional standard and non-standard signage is shown below. The three signs, W7-14-4, W7-14-6, and G9-58 are from the Australian MUTCD.



CAMUTCD and AUMUTCD (W7 & G9) At-Grade Crossing Signage

6 Active Devices

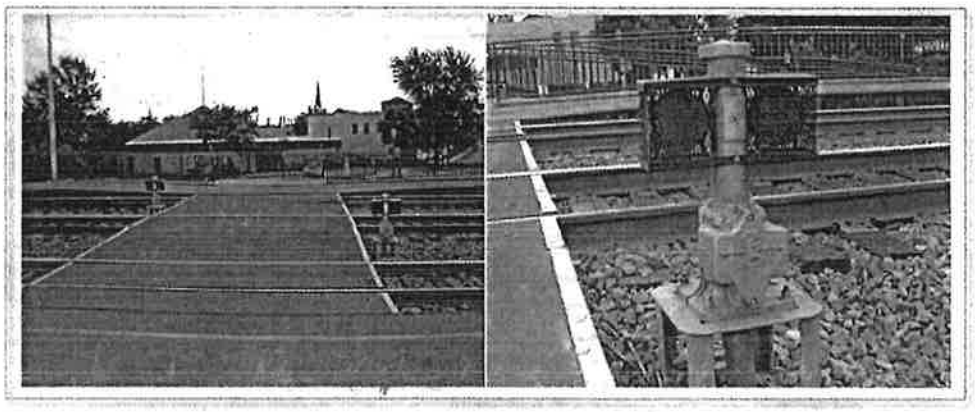
Active devices include flashers; audible active control devices; automated pedestrian gates; pedestrian signals; variable message signs; and blank-out signs. As with the passive devices, the proposed at-grade crossing design already includes a number of these types of devices as a standard to CPUC requirements.

6.1 Automated Wayside Horn System

Typically an addition to quiet zone highway at-grade crossing improvements, a wayside horn would be used to warn of an approaching train. While located at the at-grade crossing, alternatively they could be placed offset of the crossing, along the track alignment, and used in correlation with the direction of the approaching train. A northbound train would have a wayside horn activation south of the crossing, and a southbound train would activate a horn north of the crossing. Confirmation of this approach was not confirmed, but the goal would be to provide pedestrians with an audible warning from the direction of the approaching train. As an option, the UDOT Pedestrian Grade Crossing Manual provides the following recommendations for reducing the impact of Wayside Audible Devices. Additionally, an example of audible/visual warning devices is provided, used in Oregon and Illinois.

Technique	Operational Context	Recommended Action
Reduce Sound Level of Device	All crossings except those in a high-noise environment	Adjust sound level of bell, replace non-adjustable bell with adjustable bell, replace electromechanical bell with electronic device
Vary Sound Level of Device	Crossings where background sound level fluctuates	Set warning level 10 dB above ambient noise level, either by measuring ambient levels or with a time clock
Improve Directionality of Device	Crossings where noise-sensitive receptors are not in line with pedestrian approaches	Install shrouds on existing bells or replace bells with wayside horns
Lower Mounting Height of Device	Crossings where nearby walls or structures would block sound from a lowered device	Move crossing bell from top of post to location within pedestrians' field of perception
Reduce Number of Devices	Crossings with multiple gates and flashing light devices	Remove one or more crossing bells while maintaining sufficient coverage for pedestrians on all approaches

Table 3: Recommendations for Reducing Impact of Wayside Audible Devises, UDOT Pedestrian Grade Crossing Manual.

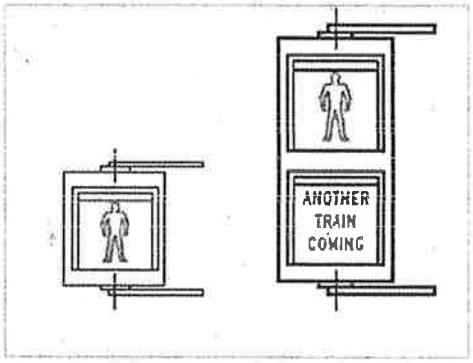


Installation of Audible/Visual Devices in Lombard, IL, on Metra's UP West Line to Elburn, FRA Compilation of Pedestrian Safety Devices in Use at Grade Crossings.

6.2 Active Traffic Signal Control System

This alternative includes variations which range from a pedestrian signal providing feedback of an impending activation via railroad pre-emption timing, to a full actuated and rail coordinated traffic signal.

Examples of activated rail warning signals can be found in San Francisco's Embarcadero (Harry Brides Plaza), where it is used in conjunction with a mid-block signal of the roadway. Alternatively, a pedestrian signal, like that shown below is used in Australia, and commences with a flashing warning phase followed by steady phase during the approach of a train. A second train may activate a secondary signal with the steady pedestrian, shown below, which is switched off at other times.



Red Symbolic Standing Pedestrian Signal (RX-12), AUMUTCD

A fully controlled actuated signal is another variation, but may require installation of automatic gates to hold pedestrians. Without gates, the pedestrian may be less likely to actuate the signal via a pushbutton. The signal would be interconnected with railroad pre-emption, holding pedestrians phase prior to a railroad device activation. While a signal without active gates may present conformance issues, the signal could be viewed as impacting pedestrian crossing times.

6.3 Train Activated Blank-out Signage

Blank-out signs that are train-activated convey specific messages to crossing users. These signs are often used at vehicle crossings or intersections to indicate prohibited movements to vehicles. However, the W10-7 blank-out sign, shown below, is an MUTCD approved sign which has been used to alert pedestrians to the presence of a rail vehicle at grade crossings. Blank-out signs provide specific messages to crossing users when a train is approaching. UDOT requires the use of blank-out where there are sight distance restrictions and multiple tracks to notify pedestrians of the approach of a train. Blank-out signs are also recommended in areas of high pedestrian activity. At crossings with multiple tracks blank-out signs can also be used to alert the pedestrian that the crossing is still occupied by a train, which could mean the approach of a second train.

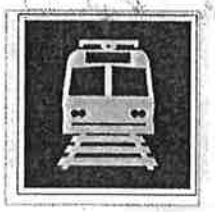


Figure 8B-101(CA), SG96 (CA),
CAMUTCD

As noted in the UDOT Pedestrian Grade Crossing Manual, when sight distance is restricted pedestrians must rely on other sources to indicate whether or not it is safe to cross. Active warning devices, including flashing-light signals and audible devices, shall be used to communicate the danger to pedestrians when sight distance restrictions prevent pedestrians from perceiving the danger. Whenever possible, sight distance should be improved to acceptable conditions. However, when sight distance cannot be improved a blank-out sign shall be provided in multi-track semi-exclusive alignments in order to alert pedestrians when a train is approaching. The image below demonstrates how additional active control devices may be used to mitigate sight distance restrictions. Notice the blank-out sign mounted on the pole between the tracks.

Figure 15: Use of Blank-out Sign for Crossings with Restricted Sight Distance,
UDOT Pedestrian Crossing Manual

6.4 Train Activated Symbolic Train Approaching Signage

This alternative would propose a train activated changeable message sign, indicating the approaching train and track reference. Shown here in a light rail location, the device could be adapted to the Jennings Avenue at-grade crossing.

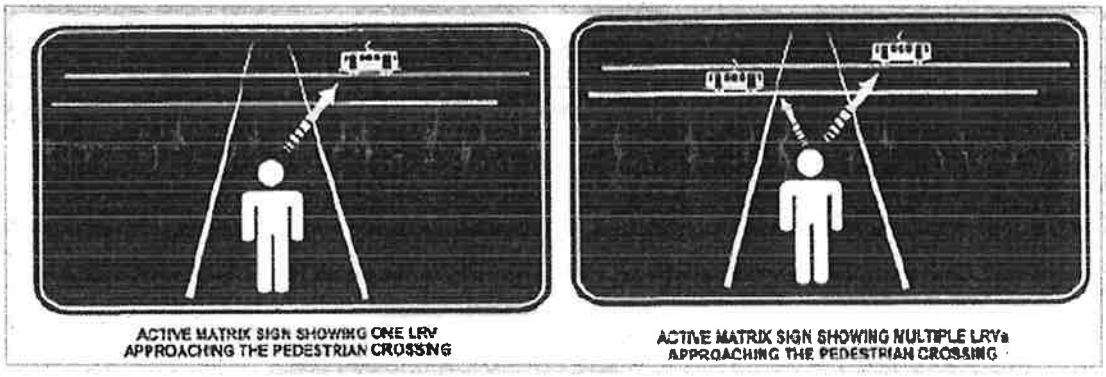


Figure 71 Example of Active Matrix Train Approaching Sign,
FHWA Railroad-Highway Grade Crossing Handbook.

7 Other Considerations

As provided in the CPUC publication "Pedestrian-Rail Crossings in California", May 2008, it is noted that the Transit Cooperative Research Program (TCRP) Report 60 presents the following figure (3-38). The figure provides a decision tree for Light Rail Service: Pedestrian and Vehicular Safety. While the figure notes Light Rail Transit (LRT), the CAMUTCD Part 8 provides similar traffic control devices that are used at highway-rail and highway-LRT grade crossings. According to the decision flow chart, the Jennings Avenue at-grade crossing as proposed, includes all treatments listed in the flow chart.

Further, UDOT refines this decision tree to provide associated activity and train traffic to determine a Safety Treatment Flow Chart for both urban and rural facilities. The charts are provided as attachments.

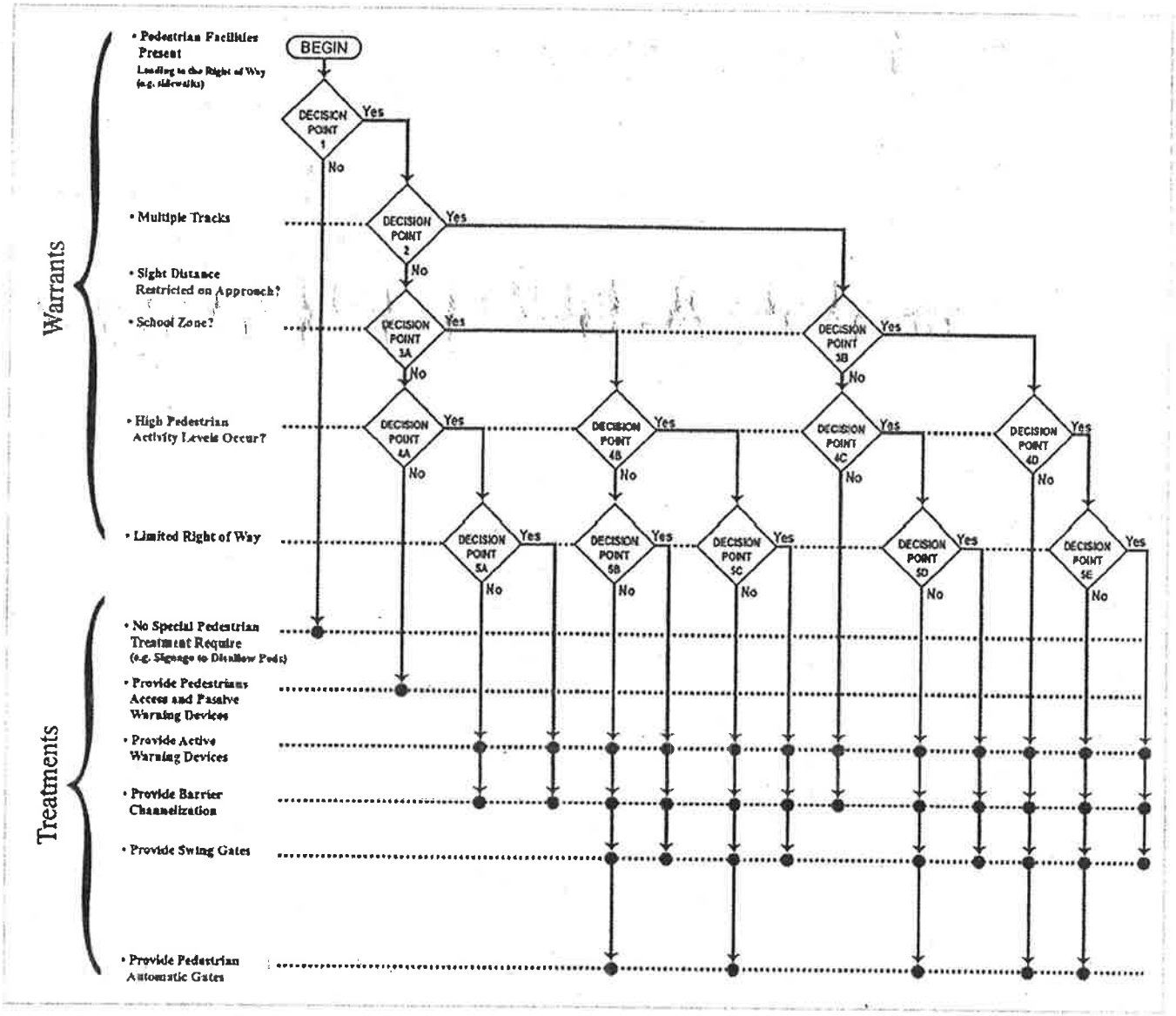


Figure 3-38 Light Rail Safety Decision Tree,
Transit Cooperative Research Program (TCRP) Report 60

Attachments

- **Exhibit 1 – Rail Crossing Layout – Rail Crossing/Equipment/Signal Systems**
- **Urban Pedestrian Grade Crossing Flow Chart, UDOT**
- **Rural Pedestrian Grade Crossing Flow Chart, UDOT**

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[i] California Public Utilities Commission (CPUC). *Rail Crossings and Engineering Branch.* Available at: http://www.cpuc.ca.gov/General.aspx?id=3913. Accessed: 3/23/2019

[ii] U.S. Department of Transportation. *Railroad-Highway Grade Crossing Handbook.* Federal Highway Administration (FHWA). Revised Second Edition, August 2007.

[iii] California State Department of Transportation. *California Manual on Uniform Traffic Control Devices, FHWA's MUTCD 2009 Edition, including Revisions 1 & 2 as amended for use in California.* California State Transportation Agency (CalSTA). 2014 Edition, Revision 3 (March 2018).

[iv] California Public Utilities Commission (CPUC). *Pedestrian-Rail Crossings In California, A Report Compiling the Designs and Devices Currently Utilized at Pedestrian-Rail Crossings within the State of California.* Richard Clark, Director, Consumer Protection & Safety Division (CPSD) California Public Utilities Commission. May 2008.

[v] Utah Department of Transportation. *UDOT Pedestrian Grade Crossing Manual.* July 2013.

[vi] Federal Rail Administration (FRA). *A Compilation of Pedestrian Safety Devices In Use At Grade Crossings.* Office of Safety, FRA. January 2008.

[vii] Australian Standard. *Manual of uniform traffic control devices, Part 7: Railway crossings.* Committee MS-012, Road Signs and Traffic Signals, Council of Standards Australia. March 21, 2016.

[viii] Federal Railroad Administration (FRA). *Railroad Trespassing, Vandalism, and Highway-Rail Trade Crossing Warning Device Violation Prevention Strategies.* December 2010.